TRANSFORMATION OF PLANORBIS.

A PRACTICAL ILLUSTRATON OF THE EVOLUTION OF SPECIES.

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II.

But we see that both the favored and unfavored found their appropriate spheres, and that even the deformities were perpetuated, and became distinctive of species.

Another characteristic which does not come under the dominion of any law of natural selection is the inevitable tendency to form an asymmetrical spiral in all the later occurring members of each series, whether progressive or retrogressive.

The lecturer then explained, by the aid of diagrams and a model, that the forms of shells are due to the successive imbricated layers built up by the border of the mantle in all mollusks. Secondly, that any force tending to compress one part of the secreting border more than another would occasion a narrowing of the imbricated layers of that part, and cause a twist or spiral to be formed. Thirdly, that the aspect of all the spirals examined shows that the shells are acted upon by such a force—gravitation, and in no other way can we account for their shape, and the obvious direction in which the compression of the border takes place.

The mathematical regularity of the spirals is explained if we admit the constant action of a universally distributed physical force upon the building up of the shell.

Diseased and outgrown, or old shells, were shown in order to enforce the fact that when an animal becomes weakened the shell shows its effect by the irregularities of the spiral. The excessively irregular forms of the oyster show that when the action of gravitation is in part eliminated the asymmetry is proportionately greater or less, and also that distortions occur in the internal soft body, as in the gills, and in the distribution and structure of the blood-vessels and mantle, which are quite different on the lower side of the adult oyster and upon the upper.

The oyster and all lamellibranchs grow *not in the direction of effort, but in that of least resistance.* The clam and the mussel were adduced to show this as well as the oyster. The forms of these shells are bilateral, but their anterior ends are compressed more than their posterior portions, therefore the valves grow faster towards the posterior than towards the anterior ends. Sooner or later when any soft-bodied animal lies habitually on its side, the originally bilateral or spherical form of the free animal must become distorted, as is the case with all attached animals, like the attached forms of protozoa, sponges, coelenterata, echinodermata, and so on. It is not difficult to show that their spiral, spherical, or bilateral symmetry is proportional, in all cases known to the speaker, to the amount of freedom in the growth of the parts; the freer the part the more symmetrical, the more attached or supported the more asymmetrical. Examples of shells like those of *Magilus antiquus* were cited in support of this view.

The attraction of gravitation is eliminated during the growth of this shell, by the coral which surrounds it; and the result, as also in the cases of many of the Vermetidæ, which receive a similar perfect support, is the formation of a wholly irregular tube, though the young are, while still free, provided with the ordinary turreted shell.

To show that the bilaterality of soft parts was produced by the attraction of gravitation on a soft growing body, the lecturer described several illustrations, especially the case of the Eolidæ, which have a coiled shell in the young, but lose this and become, during growth, perfectly symmetrical and soft-bodied. He also showed, that in no other way can we account for the extraordinary mixture of asymmetry in the shells and symmetry in the softer, free moving parts of the same animal among the Gasteropoda and other animals. The effects of heredity were also discussed, and it was shown that when a symmety, as distortion, was introduced, it occurred usually on the outer whorl, or during the latter stages of the growth, and that as time went on, this same characteristic appeared at earlier and earlier stages in the growth of successive descendants. The final effect of this law is the entire replacement of older ancestral characteristics by those which are newly introduced.

Thus the turreted asymmetrical spiral is found, as in the Steinheim shells, to gradually replace the more nearly symmetrical form of the immediate ancestors and the absolutely symmetrical form of the disc or shell, ovishell, as it is called, in all species. It was claimed that this law of heredity was absolute and independent, as one of the results of growth; and, that neither the variations, such as the formation of the asymmetrical spiral, nor its perpetuation and increase in successive generations of forms could be attributed to any law of natural selection.

The lecturer then, however, proceeded to show that the differences between the different series of shells could only be accounted for on the supposition of advantage and disadvantage, and took the ground that the Darwinian hypothesis applied perfectly to the explanation of the survival of only four distinct varieties out of the many which emigrated into the Steinheim basin, and tried to prove this by numerous instances quoted from Verrill and other authorities, showing that uniform physical causes must have a certain uniformity of result, which was not the case with the differences of the different series.

When, however, the action of natural selection had maintained the new differences for a certain length of time, until they had begun to be inherited, he claimed that it ceased to have any farther effect upon the organization.

Wherever the species might be found or whatever the surroundings there would be one thing absolutely certain; the forms during their growth would repeat the selected differences during their early stages of growth. In other words, the characteristics originally established by reason of their advantage or disadvantage in the battle of life, as soon as they become fixed in the organization, are no longer under the control of natural selection, which must vary with the immediate surroundings, but under that of heredity by acceleration.

The conclusions, besides those given in your report, were as follows:

"At the base of this conception of an animal lies growth."

Arising by growth through processes, which have been extensively studied, are, the bud, the egg, and all the phenomena connecting animals and plants according to the laws of heredity.

The action of growth and heredity, under the constant control of physical forces * gives the forms and many of the characteristics which distinguish a form from its immediate parents or ancestors, or from the forms occurring in other localities; in other words, the variations. The mutual action and re-action of animals and plants upon one another according to the laws of natural and sexual selection, etc., give it fixity in the organization to certain of these variations.

* Of course, in this view, the physical force is the immediate cause of every condition of symmetry of form, as well as of every variation not derived from inheritance. The animal, in other words, is looked upon as a plastic, growing organism, acted upon from outside by physical forces, which modify it perpetually, and upon which it re-acts by means of its powers of growth and heredity. The former tend to cause perpetual variation, the latter to preserve the type by renewing—"rejuvenating" it perpetually in each successive generation.

We cannot account for the suitability of organisms, and their adaptations to every situation in time, as the distribution on the existing surface of the earth, or for the results of experimental zoology, without acknowledging the paramount influence of physical forces.

Nor can we, on the other hand, account for the comparative invariability of the embryo for indefinite periods of past time, or for the preservation of the type in spite of the perpetual changes introduced by physical changes on the earth's surface, unless due weight be given to the reaction of the growth forces and heredity by acceleration, which tend to preserve original types comparatively unchanged.

An organism is not entirely at the mercy of the elements, but possesses a power which, within a certain sphere, acts not only for the preservation of its life, but also for the preservation of its own characteristics, and, through heredity, causes the perpetual recurrence of similar characteristics and similar changes, what are usually called parallelisms, in successive generations of genetically connected individuals, forms a species wherever they occur in time, and under whatever circumstances of local distribution upon the surface of the earth.

Manufacture of Factitious Butter in thr United States.—A compilation from American and English sources shows that factitious butter contains only 1.823 per cent. of butyrine, caprine, caproine, and capryline, as against 7.432 per cent. in the natural product.—*Moniteur Scientifique.*